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REMARKS

Applicants thank the Examiner for careful consideration of the application.

No claims have been allowed by the Examiner.

I. Rejections under 103:

Examiner has rejected claims 1-19 and 21-36 under 35 U.S.C. §103(a) as being unpatentable over Ota et al. (JP 06183000A, abstract only, "Ota") in view of Ishida et al. (U.S. 5,229,438, "Ishida"). This rejection is respectfully traversed with regard to claims 1-19 and 21-36 since neither of the cited references, taken either individually, or in combination therewith, teaches, suggests, or mentions the claimed invention.

To establish a prima facie case of obviousness, three basic criteria must be met. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, i.e. the prior art must suggest the desirability of the claimed invention. There must be a reasonable expectation of success. Finally all claim limitations must be taught or suggested by the prior art. MPEP §2143. These requirements are not met here.

As applicants previously pointed out independent claim 1 discloses a "fluid ejection cartridge, comprising: *a substrate carrier having a substrate receiving surface; a substrate . . . and a two-part adhesive disposed between said substrate and said substrate receiving surface*, wherein said two-part adhesive comprises: an epoxy resin having a polyglycidyl ether of a polyhydric phenol; and a hardener having 3-aminomethyl-3,5,5-trimethyl-1-cyclohexylamine." Applicants respectfully disagree with Examiner's interpretation of the Ota abstract. Applicants believe that Examiner fails to identify in the Ota abstract any structure that Examiner considers as "a substrate carrier having a substrate receiving surface" as claimed in the instant specification, and fails to identify in the Ota abstract any structure that Examiner considers is "a substrate" as claimed in the instant specification. Although Examiner has failed to clearly state a clear relationship between the Ota abstract and the applicants claimed limitations, Applicants assume and

respectfully disagree that if Examiner is interpreting nozzle plate 2 in the Ota abstract as either a substrate or a substrate receiver as claimed in the instant specification. In addition, the Ota abstract fails to identify structures 1, 6, 4, or 5 which Examiner states "[t]he heads also have bases 5 below the channels (Figure 2). Applicants note that Figure 2 does show a structure labeled as number 5, however, no reference is made to that number in the abstract.

Even assuming for purposes of arguing that the nozzle plate 2 as disclosed in the Ota abstract is either a substrate or substrate carrier, which Applicants believe is incorrect, Applicants still respectfully disagree with Examiner's interpretation of the Ota abstract. Examiner correctly notes that the Ota abstract teaches ink-jet heads having a nozzle plate 2, with one or several nozzles (3) and having several channels forming an in cavity (8) and a means to generate pressure to discharge ink drops. Applicants assert that Examiner then incorrectly states that "the plates are bound to the channels in streamlined fashion using a "filler" 7 that contains an epoxy resin . . . ." Applicants note that the Ota abstract actually states "(2) [i.e. the nozzle plate] is bonded to the ink channels so that each nozzle corresponds to each ink cavity (8) and [sic]so the opening to discharge the ink drops is formed." Applicants assert that the Ota abstract does not state that "filler" 7 binds the nozzle plate 2 to the ink channels. The Ota abstract simply states that nozzle plate "(2) is bonded to the ink channels." Applicants believe that a more reasonable interpretation is that nozzle plate is independently bonded to structure 1 and structure 4 and that "filler (7) is applied to the corner [of ink cavity] (8) and [nozzle plate] (2) so that [the ink cavity] (8) becomes streamlined from the wall of the ink channel to the nozzle.

Applicants, in part base this interpretation on the lack of cross-hatching showing "filler" 7 disposed between nozzle plate (2) and structure (1) and structure (4), where as Ota in figure 1 does show filler 7 forming part of nozzle 3. In addition, Applicants also note that Ota discloses:

> "[w]hen holes are created in a plate by using high-energy beams, for example with excimer laser processing, the diameter of the hole on the surface affected by the laser beams is normally greater than the diameter of the hole on the reverse surface through which the beams are passing. Accordingly, after the main head unit has been attached to the nozzle plate, a hole corresponding to the ink cavity forming the liquid channel is formed with this processing method and because a reversed taper shape is formed in the direction opposite

> to the direction of ink ejection, it is not possible to perform stable ejection of ink droplets with this design. In addition, when the method using a technique creating holes is applied to a nozzle plate with the method described above, after the holes have been formed, an alignment corresponding to the body cavity is required, so that complicated operations are created during this stage because contact with the nozzle plate must be achieved."

See page 2 paragraph 0004 (Goals to Be Achieved By This Invention) in attached translation. In addition, Ota discloses that figure 1:

> "shows an enlarged profile view explaining one embodiment of the inkjet head of the present invention. Figure 2 shows a perspective view of the entire unit of one embodiment of an inkjet head compatible with this invention. In these Figures 1 and 2, 1 is an ink channel plate, 2 is a nozzle plate, 3 is a nozzle, 4 is a pressure generation member, 5 is a base plate, 6 is a cover plate, and 7 is and angle filling member added according to this invention.
>
> (0008) The inkjet head is shown in Figure 1 and Figure 2 in an enlarged profile view in the vicinity of the nozzle as a profile view in the longitudinal direction of the channel, wherein a nozzle plate 2 is connected so as to create a lid on an ink cavity 8 formed by a channel plate 1 and a cover plate 6, while the nozzles are formed by irradiation with high-energy beams, for example with excimer laser beams, from the outer side of the ink cavity, so as to correspond to each ink cavity 8. The diameter of the formed nozzle is greater than the diameter of the inner part of the ink cavity irradiated with laser beams on the side of atmospheric air."

See page 3 paragraphs 0007 and 0008. Further, Ota discloses:

> an inkjet head having a nozzle plate provided with one or multiple nozzles . . . having one or several channels forming an ink cavity, . . . wherein an ink droplet ejection outlets are formed connected so that said nozzle plate and ink channels are deployed opposite each nozzle and ink cavity; having a filling member which fills an angular part created inside said cavity of the part connecting said ink channel and said nozzle plate so as to eliminate the angular part; wherein in this inkjet head: (2) said angle filling member is formed to create a streamlined shape of the ink cavity from the wall face of the ink channel to the nozzle . . . ."

See page 3 paragraph 0006 (Means to Solve Problems) .

Thus, Applicants respectfully disagree with Examiner's statement in the previous Office Communication that "[t]he 'filler' is deemed to be an adhesive because it helps seal the plates to the channel-forming structures 1 (Figure 1). Applicants assert Ota clearly discloses an inkjet head formed by attaching a nozzle plate (2) attached to a channel plate (1) and a cover plate (6) and then forming nozzles in the nozzle plate after attachment and then after formation of the nozzles the forming of a filling member (7) that fills an angular part created inside cavity (8) to form a streamlined shape; and does not disclose a "fluid ejection cartridge, comprising: *a substrate carrier having a substrate receiving*

surface; a substrate . . . and a two-part adhesive disposed between said substrate and said substrate receiving surface, wherein said two-part adhesive comprises: an epoxy resin having a polyglycidyl ether of a polyhydric phenol; and a hardener having 3-aminomethyl-3,5,5-trimethyl-1-cyclohexylamine," as recited in independent claim 1 in the instant specification.

Ishida, on the other hand, discloses a "two component, or two-part resin composition which adheres well to wet mortar and concrete . . . ." See Abstract. Ishida does not disclose a "fluid ejection cartridge, comprising: *a substrate carrier having a substrate receiving surface; a substrate . . . and a two-part adhesive disposed between said substrate and said substrate receiving surface*, wherein said two-part adhesive comprises: an epoxy resin having a polyglycidyl ether of a polyhydric phenol; and a hardener having 3-aminomethyl-3,5,5-trimethyl-1-cyclohexylamine," as recited in independent claim 1 in the instant specification. In addition, Applicants respectfully disagree with Examiner's statement that the references are analogous because both deal with epoxy adhesives. First Applicants note that Ota utilizes an epoxy resin as a filling material and only suggests utilizing an epoxy resin have a relatively low adhesiveness to join the nozzle plate to the channel plate and cover plate. Second Applicants also note that Ishida is directed to an epoxy adhesive which adheres well to wet mortar and concrete. Applicants assert that one of ordinary skill in the art of manufacturing fluid ejection cartridges would not look in the art of adhesives designed to adhere to wet mortar and concrete. Further, even if one of ordinary skill in the art of manufacturing fluid ejection cartridges would look to adhesives used to adhere to wet concrete there would be no reasonable likelihood of success without undue experimentation. Applicants, have been unable to find any reference or suggestion in Ishida of adhesion of the resin to materials other than wet mortar and concrete. Applicants, hereby request Examiner to particularly point out where in Ishida such disclosure is made to materials that would normally be utilized to form fluid ejection cartridges.

Thus, the Examiner's suggested combination (which may or may not be proper) of the Ota abstract and Ishida does not teach the present invention as recited in independent claim 1 and thus does not meet any of the three basic criteria that must be met to establish

a prima facie case of obviousness under MPEP §2143. Accordingly, Applicants assert that the rejection has been overcome. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of independent claims 1 and 33 based on the Ota abstract in view of the Ishida under 35 U.S.C. § 103(a).

In regards to the dependent claims, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. MPEP 2143.03. Dependent claims 2-19 and 21-32 are dependent upon independent claim 1 and dependent claims 34-36 are dependent upon independent claim 33, and are therefore believed to be allowable as dependent upon a believed allowable claim. Accordingly, Applicants assert that the rejection has been overcome. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of dependent claims 2-19, 21-32 and 34-36, under 35 U.S.C. § 103(a).

In addition, Applicants respectfully disagree with Examiner that the "limitations recited in claims 2-19 and 34-36 deal with intended use and do not distinguish the claimed adhesive-bound cartridges from those suggested by the combined references." Applicants argue that even if Examiner's suggested interpretation is correct then dependent claim 2 must be allowable since dependent claim 2 discloses "at least one nozzle proximate to said at least one fluid ejector actuator disposed over said substrate." Applicants, assert that the limitation of at least one nozzle of claim 2 cannot be both nozzle and substrate or substrate carrier since they are separate and distinct limitations. Neither the Ota abstract nor Ishida disclose, teach or suggest, "wherein activation of said fluid energy generating element ejects essentially a drop of a fluid from said at least one nozzle, and the volume of the fluid, of essentially said drop, is in the range of from about 5 femto-liters to about a 900 pico-liters," as it is disclosed, defined, and claimed, in dependent claim 4 by the Applicants in the instant specification. Further, Applicants, note that dependent claims 2-17 all disclose various structural limitations that do not deal with intended use and do distinguish the claimed invention different from that suggested by the combined references. For example, claim 9 discloses a fluid definition layer, claim 10 discloses a chamber layer defining sidewalls of a chamber and an orifice layer defining a bore, claim 11 discloses fluid inlet channels formed in said substrate, claim 16 discloses

at least one active device disposed on said substrate, and claim 17 discloses a transistor. Applicants also note that claims 18-19, and claims 21-32 are drawn to various limitations on the adhesive disclosed in independent claim 1 and thus, do not deal with intended use and do distinguish the claimed invention of the instant specification over that suggested by the combined references.

Therefore, in view of the foregoing Amendment and Remarks, Applicants believe the present Application to be in a condition suitable for allowance. Examiner is respectfully urged to withdraw the rejections, reconsider the present Application in light of the foregoing Amendment, and pass the amended Application to allowance.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is respectfully requested to call Applicants' representative at (541) 715-1694 to discuss the steps necessary for placing the Application in condition for allowance.

Favorable action by the Examiner is solicited.

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(19) JAPANESE PATENT OFFICE (JP)

(12) PUBLICATION OF UNEXAMINED PATENT APPLICATION (A)

(11) Kokai (Unexamined) Patent Publication Number: 6-183000

(43) Date of Disclosure: July 5, 1994

(51) Int. Cl.[5]	Identif. Symbol	Intra-Agency Number	FI	Technology Disclosure
B 41 J 2/045		7346-5H		
2/055				
2/16				
	9012-2C		B 41 J 3/04	103 A
	9012-2C			103 A

Examination requested: not yet requested
Number of Claims: 7 (total of 5 pages)

(54) Title of the Invention: INKJET HEAD AND MANUFACTURE THEREOF

(21) Application Number: 4-356638
(22) Filing Date: December 21, 1992

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(54) (Title of the Invention): Inkjet Head and Manufacture Thereof

(57) Summary

(Goal)

The goal is to provide an inkjet head and a manufacturing method for an inkjet head characterized by precision and a high reliability.

(Construction)

The construction comprises a nozzle plate 2, having one or several nozzles deployed opposite a recording medium, one or several channels forming an ink cavity 8, and a pressure generating means generating pressure in order to eject ink droplets; wherein said nozzle plate 2 and ink channel(s) are connected in such a way so that each nozzle 3 is located opposite an ink cavity 9, forming an ink ejection outlet. The angular part of the part connecting said ink channel and said nozzle plate is filled with an angle filling member 7 created in order to eliminate the angle.

[see Figure]

[page 2]

(Scope of the Patent's Claims)

(Claim 1)

An inkjet head, characterized by the fact that it is provided with a nozzle plate having one or multiple nozzles arranged opposite a recording medium;

having one ore several channels, which serve to form an ink cavity;

and a pressure generation means, which serves to generate pressure to eject ink droplets;

in an inkjet head forming an ink droplet ejection outlet, wherein said nozzle plate and said ink channels are joined so as to correspond to each of the nozzles in the ink cavity;

and an angle filling member, which serves to eliminate an angular part crated inside said cavity in the part joining said ink channel with said nozzle plate.

(Claim 2)

The inkjet head described in claim 1, characterized by the fact that said angle filling member is created with a shape enabling to create a streamline shape of the ink cavity from the wall surface of the ink channel to the nozzle.

(Claim 3)

The inkjet head described in claim 1 or claim 2, characterized by the fact that said angle filling member is an epoxy-based resin.

(Claim 4)

The inkjet head described in claim 3, characterized by the fact that said epoxy-based resin is a two-component liquid epoxy resin hardening at normal (or medium) temperature.

(Claim 5)

The inkjet head described in claim 3, characterized by the fact that a reactive diluent is added to said epoxy-based resin.

(Claim 6)

Inkjet head manufacturing method, characterized by the fact that it is provided with a nozzle plate having one or multiple nozzles arranged opposite a recording medium;

one ore several channels, which serve to form an ink cavity;

and a pressure generation means, which serves to generate pressure to eject ink droplets;

in an inkjet head forming an ink droplet ejection outlet, wherein said nozzle plate and said ink channels are joined so as to correspond to each of the nozzle in the ink cavity;

wherein when an ink cavity is filled with a fluid resin, next, while gas is supplied from the side of the ink cavity and passes through nozzle until it is discharged when external air is reached, said resin having fluid characteristics is formed in the angular part inside the cavity joining said ink channel with said nozzle plate.

(Claim 7)

The inkjet head manufacturing method of claim 6, characterized by the fact that the gas flowing during the formation of said fluid resin channel is a heating gas.

(Detailed Explanation of the Invention)

(0001)

(Sphere of Industrial Use)

This invention relates to an inkjet head deployed in an inkjet recording apparatus, more specifically it relates to an inkjet head and a method to manufacture an inkjet head which has a superior high-frequency responsiveness.

(0002)

(Prior Art Technology)

In order to ensure a stable and high print quality of inkjet heads provided with a superior high frequency responsiveness, the inner part of the inkjet cavity is completely filled with ink during certain operations and when energy is applied to achieve ejection of ink droplets, operations are required so as to eject ink droplets without losing this energy. However, since there is a possibility that an air bubble will be drawn in when reaction negative pressure is generated immediately after the ejection of an ink droplet, the representative commercial product designs listed below were employed according to prior art as a measure preventing drawing in of air bubbles.

(0003)

(1) A member, such as a channel plate forming an inkjet cavity, is deployed so as to restrict gradually the part in the vicinity of the nozzle part with injection molding or a similar type of processing which is used to create a taper shape facing the nozzle.

(2) When nozzles are formed in a nozzle plate, high-energy beams are utilized, for example with excimer laser or the like, to create a taper shape of the nozzle unit itself.

(3) The wettability is increased with metal plating of the nozzle plate in which nozzles are formed and a thin ink film is formed in a part in the vicinity of the nozzles of the nozzle plate.

(4) The nozzle holes are formed with a punch and a die (for example Japanese Japanese Unexamined (Kokai) Patent Application No. 4-39053).

(0004)

(Goal to Be Achieved By This Invention)

However, the methods mentioned above suffer from the following drawbacks.

(1) High-precision processing on the order of several μm is required to create a restricting part which is used to restrict a channel plate or the like with a restricting member.

(2) When holes are created in a plate by using high-energy beams, for example with excimer laser processing, the diameter of the hole on the surface affected by the laser beams is normally greater than the diameter of the hole on the reverse surface through which the beams are passing.

Accordingly, after the main head unit has been attached to the nozzle plate, a hole corresponding to the ink cavity forming the liquid channel is formed with this processing method and because a reversed taper shape is formed in the direction opposite to the direction of ink ejection, it is not possible to perform stable ejection of ink droplets with this design. In addition, when the method using a technique creating holes is applied to a nozzle plate with the method described above, after the holes have been formed, an alignment corresponding to the body cavity is required, so that complicated operations are created during this stage because contact with the nozzle plate must be achieved.

(3) When a thin film of ink is formed on a nozzle plate, it is difficult to control the amount of the ink required to form a thin film. Moreover, because an ink mist is normally created in locations that are very close to the printed text, poor control can easily exert an influence on the print quality.

(4) The operations are complicated because a burr removing stage is required after the hole-creating stage, together with inspection control.

(0005)

The goal of this invention is to resolve the problem areas described above by providing an inkjet head and an inkjet head manufacturing method which is not only precise, but also highly reliable.

(0006)

[page 3]

(Means to Solve Problems)

In order to achieve the goals of this invention, the invention is characterized by the following: (1) an inkjet head having a nozzle plate provided with one or multiple nozzles arranged opposite a recording medium, having one or several channels forming an ink cavity, and a pressure generation means generating pressure in order to eject ink droplets in an inkjet head, in an inkjet head wherein an ink droplet ejection outlets are formed connected so that said nozzle plate and ink channels are deployed opposite each nozzle and ink cavity;

having a filling member which fills an angular part created inside said cavity of the part connecting said ink channel and said nozzle plate so as to eliminate the angular part;

wherein in this inkjet head: (2) said angle filling member is formed to create a streamlined shape of the ink cavity from the wall face of the ink channel to the nozzle, or

(3) said angle filling member is made from an epoxy-based resin, or

(4) said epoxy-based resin is a hardening type of resin being a two-component liquid epoxy resin hardening at normal temperature(or medium temperature), or

(5) said epoxy-based resin is characterized by an addition of a reactive diluent.

Moreover, (6) the construction is provided with a nozzle plate having one or multiple nozzles arranged opposite a recording medium, one or multiple channels forming an ink cavity, having a pressure generation means generating pressure in order to eject ink droplets according to a manufacturing method, wherein an inkjet head is formed with ink droplet ejection outlets connected so that said nozzle plate and ink channels are deployed opposite each nozzle and ink cavity, while a fluid resin fills the inner part of the ink cavity. Next, while air passes from the side of the ink cavity and is discharged to atmospheric air, the angular part inside the cavity of part connecting said ink channel with said nozzle plate is filled with said fluid resin. In addition, the air used during item (6) is heated air which is circulated during the formation of said fluid resin (7).

(0007)

(Embodiments)

Figure 1 shows an enlarged profile view explaining one embodiment of the inkjet head of the present invention. Figure 2 shows a perspective view of the entire unit of one embodiment of an inkjet head compatible with this invention. In these Figures 1 and 2, 1 is an ink channel plate, 2 is a nozzle plate, 3 is a nozzle, 4 is a pressure generation member, 5 is a base plate, 6 is a cover plate, and 7 is and angle filling member added according to this invention.

(0008)

The inkjet head is shown in Figure 1 and Figure 2 in an enlarged profile view in the vicinity of the nozzle as a profile view in the longitudinal direction of the channel, wherein a nozzle plate 2 is connected so as to create a lid on an ink cavity 8 formed by a channel plate 1 and a cover plate 6, while the nozzles are formed by irradiation with high-energy beams, for example with excimer laser beams, from the outer side of the ink cavity, so as to correspond to each ink cavity 8. The diameter of the formed nozzle is greater than the diameter of the inner part of the ink cavity irradiated with laser beams on the side of atmospheric air. In addition, while the formation of the nozzle 3 can be performed by connecting nozzle plate 2 to the end part of the ink cavity ahead of time, the nozzle diameter can be in this case greater on the side inside the cavity. However, since the formed nozzles must be connected to a corresponding ink cavity, alignment with a high precision necessitates a technique for formation of an adhesive layer so as prevent the nozzle from being filled at the time of the adhesion.

(0009)

Figure 4 shows one example of a conventional inkjet head created with a shape tapered toward the nozzle, wherein a member 1 of the channel plate, etc., is gradually tapered toward a nozzle 3 of a nozzle plate 2 to create a constricting part and a channel. Although ejection of air bubbles can be easily achieved because a restricting part 9 is deployed as shown in this figure, the molding of this restriction is very difficult.

(0010)

Figure 5 is a figure showing an example of prior art in which no restriction (restriction 9 in Figure 4) is created along the end part of a nozzle plate 2 on a channel plate member 1. In this case, an angular part 10 is created for channel plate 1 and nozzle plate 2 as shown in the figure. This angular part 10 can easily trap air bubbles received from the nozzle during the ejection of ink droplets and because it is very difficult to discharge an air bubble once it has been trapped, this is one reason why stability of the discharging of ink droplets is greatly reduced. In contrast to that, since according to the invention, the angular part has an angle filling part 7 as shown in Figure 1, air bubbles will not be trapped in the angular part as was the case in the conventional inkjet head shown above.

(0011)

Next, the molding method used for molding said angle filling member 8 will be explained. A head, provided with the shape of nozzles molded as shown in Figure 5 according to the above-explained procedure, is filled with a small amount of resin which has a low viscosity and hardens at normal temperature, supplied from the ink supply channel into the head ink cavity. Excessive resin is removed and in order to adjust the shape of the angle filling member, nitrogen, air and other gases flow from the ink supply channel. The amount of gases, from which excessive resin has been smoothly removed outside of the system, as well as the flow rate are adjusted so that a continuous gas flow can be continued while the shape of the angle filling member is maintained until the resin hardens after the expulsion. When this occurs, the corner filling member forms a streamline shape, which is an ideal shape for the ink flow. The formation time period can be also greatly reduced when heating is applied to promote hardening to the flow of the gas up to the vicinity of the resin hardening temperature (40 ~ 80°C).

(0012)

A two-component liquid epoxy resin hardening at normal temperature is a suitable resin for said low-viscosity thermosetting resin to be used for formation of said angle filling member. Taking into account also resistance to ink, epoxy resins used as epoxy phenol-based or nitrile phenol-based adhesive agents, acid anhydride-based products containing a hardening agent, or aromatic polyamine-based products are superior, although a curing temperature above 150°C is required in any case. If several materials are used to form the construction a head for suitable ink droplet ejection characteristics (for example when polyphenylene sulfide (PPS), or polycarbonate (PC) or the like is used for the ink channel plate, and PZT or a similar ceramic or silicon based

plate is used for the pressure generation member), there will be a difference in the linear thermal expansion coefficient.

[page 4]

It is therefore desirable to employ a processing method that does not involve application of a high temperature to the head. That is why it is desirable to use a chain-shaped fatty polyamine as a hardening agent that hardens at normal or medium temperature (about 80°C), or an adhesive that is based on a ring-shaped fatty polyamine, or a fatty aromatic polyamine. Such hardening agents have a relatively high amine value and a low viscosity even while hardening is still in progress when a small amount of the hardening agent used per the epoxy resin also before the hardening is completed, and they also tend to be resistant to swelling due to ink, when compared epoxy resins cured with a polyamide amine type of a hardening agent, which is another type of hardening agent that hardens at normal temperature.

(0013)

In order to create a highly integrated design of the inkjet head and to improve the ink droplet ejection characteristics, the diameter of the nozzle 3 formed in the nozzle plate 2 is less than 30 μm. However, when a finely detailed construction is required as explained above, it is difficult to form said angle filling member 7 in an ideal shape with the viscosity range (1,000 to several thousands cps) of the two-component liquid type of epoxy resin hardening at normal temperature. That is why approximately from 10 to 30% of a reactive diluent is added, such as butyl glycidyl ether (BGE, viscosity 1.5 cps/25°C), or styrene oxide (SO, viscosity 2 cps/25°C), phenyl glycidyl ether (PGE, viscosity 7 cps/20°C), or cresyl glycidyl ether (CGE, viscosity 6 cps/25°C), so that when the viscosity is greatly reduced (see Figure 3) and the excessive resin remaining inside the ink cavity as described above can be removed smoothly from the nozzles..

(0014)

According to another method that can be used for the formation of the angle filling member 7, the nozzle plate 2 is coated with a resin in a suitable thickness having adhesive characteristics, whose adhesiveness has been adjusted ahead of time to a relatively low level (for example the two-component liquid epoxy resin hardening at normal temperature mentioned above), so that the angle filling member is formed with a protruding adhesive resin together with the joining of the nozzle plate. However, since according to this method it is difficult to form the streamlined shape (Figure 1), which is an ideal shape for ejection of ink droplets, and after the joining of the nozzle plate, the diameter of the nozzle will be eventually greater on the side of external air than on the side of the ink cavity, when nozzle processing is performed for example with excimer laser. This shape has a detrimental influence on the stability of ejection of ink droplets. Moreover, it is also very difficult to eliminate fluctuations in the shape of the angle filling member between various nozzles when a multi-nozzle head is manufactured. Therefore,

the method for formation of the angle filling member can be selected so that the gas flow is iduced as described above.

(0015)

(Effect)

As is evident from the explanation above, the present invention has the following effects. Because in accordance with claim 1 of this invention, the invention provides an angle filling member which serves to eliminate angles in an angular part of the part joining an ink channel with a nozzle plate, this makes it possible to provide a highly reliable inkjet head characterized by a great degree of stability thanks to the fact that drawing in of air bubbles from the nozzle has been eliminated. In accordance with claim 2 of the invention, a streamlined type of shape is created for the shape of the angle filling part disclosed in claim 1, making it possible to provide an inkjet head enabling to achieve more efficiently the effect describe above. In accordance with claim 3 of this invention, the property used for the angle filling member disclosed in claim 1 and claim 2 is an epoxy-based resin, which facilitates the formation of the angular part. In accordance with claim 4 of this invention, when a high-temperature environment is not created during the formation of the angle filing part in the head construction, and a two-component liquid epoxy resin hardening at normal temperature (or medium temperature) is used in the epoxy-based resin disclosed in claim 3, it is not necessary to apply heating to a high temperature to a hardening type of material, making it possible to provide an inkjet head enabling to achieve more efficiently the effect described above. In accordance with claim 5, because the viscosity is reduced in resin used in the angle filling member which has not hardened yet, which is required to form the angle filling member with fine precision, namely the angle filling member disclosed in claim 1 and claim 2, a means is created enabling to attain this effect more efficiently. In accordance with claim 6 of the invention, since an ideal shape of the angle filling member disclosed in claim 1 and claim 5 is created, creating a manufacturing method enabling homogenous formation in a simple manner, the inkjet head can thus be manufactured so as to achieve this effect. In accordance with claim 7 of this invention, according to the angle filling member formation method disclosed in claim 6, the time period required until the formation of the member is reduced, creating an efficient means enabling to improve the quality.

(Brief Description of the Drawings)

(Figure 1)

The figure shows an enlarged cross-sectional view (in the longitudinal direction of the inkjet head channel) of the important parts of one embodiment of an inkjet head according to the present invention.

(Figure 2)

The figure is a perspective view showing one example of an inkjet head compatible with

this invention.

(Figure 3)

The figure shows one example of the viscosity reducing effect of a reactive diluent.

(Figure 4)

The figure shows an enlarged cross-sectional view of the nozzle part indicating one example of a conventional inkjet head.

(Figure 5)

The figure shows an enlarged cross-sectional enlarged view of the nozzle part in another example of a conventional inkjet head.

(Explanation of Symbols)

1 ... ink channel plate, 2 ... nozzle plate, 3 ... nozzle, 4 ... pressure generation member, 5 ... base plate, 6 ... cover plate, 7 ... angle filling member, 8 ... ink cavity, 9 ... constricting part, 10 ... angular part.

[page 5]

(Figure 1)

(Figure 2)

(Figure 3)

The effect of dilution in a representative example of a diluent
Base resin: Epikote 828

↑ Viscosity (poise at 25°C)
→ Diluent addition amount (wt %)

(Figure 4)

(Figure 5)

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